Explor Anim Med Res,
Vol.9, Issue - 1, 2019, p. 5-14

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

TRANS-FATS OF PROCESSED AND FRIED FOODS – A CHOICE FOR TASTE OR SERIOUS HEALTH PROBLEMS?

During last a few decades, scientists are reporting about detrimental health effects of saturated fats – the fats stay solid at room temperature. But from the research performed during last a few years, it appears that the saturated fats are dwarf in comparison to the detrimental health effects incurred through intake of Trans fats.

Fats in our diet and their effects

Fats serve as a major source of energy. Fats are generally hydrophobic, insoluble in water and are soluble in organic solvents. They serve many important structural and metabolic functions of the body. They are the most energy dense nutrients and so a necessary part of our diet. Fats help in absorption of some vitamins and minerals in the gut, which is very important. They are needed to build cell membranes and the sheaths surrounding nerves. Fats are also essential for many important physiological functions like blood clotting, muscle movement etc. (Harvard 2018).

Fat includes Glycerol and Fatty acids. Glycerol is made up of three carbon atoms. One of those bonds is made with a hydroxyl-group. Fatty acids have a long chain of carbons. On one end of the chain there is a carboxyl-group (Zundel, Study.com).

The difference of one fat to another is the length and shape of the carbon chain and the number of hydrogen atoms connected to the carbon atoms. Slight differences in structure of fat molecules can bring crucial differences in their form and function (Harvard 2018).

According to the chemical structure as well as effects on our health, the fats can be categorized as Saturated, Mono-unsaturated, Poly-unsaturated and Trans fats (Am Heart Assoc, Dilatory fats 2014).

Saturated fats

Saturated fats are the fat molecules that have no double bonds between carbon molecules as all of them are saturated with hydrogen molecules. So, the fatty acid chains of saturated fats have all or predominantly single bonds (-C-C-). Saturated fats are generally remained solid at room temperature (Zundel, Study.com).

Source: Most of the animal fats are saturated in nature. Fats present in beef, lamb, pork, poultry, tallow (separated beef fat), lard (separated pork fat), cream, butter, cheese etc. are all saturated in nature. Palm oil, palm kernel oil, coconut oil etc. plant-based oils also contain high percentage of saturated fats (Am Heart Assoc, Saturated fat 2015).

Many processed foods, baked goods and fried foods are prepared with saturated fats and so automatically rich in saturated fats (Am Heart Assoc, Saturated fat 2015). A diet rich in saturated fats can drive up total cholesterol, increase more the harmful or bad Low-Density Lipoprotein (LDL) cholesterol along with a little good High-Density Lipoprotein (HDL) cholesterol.

Many years of epidemiological research have shown that populations consuming diets high in saturated fatty acids show relatively high levels of serum cholesterol and carry a high prevalence of coronary heart disease (Caggiula and Mustad 1997). The LDL cholesterol can cause formation of blockages in the arteries of the heart and elsewhere in the body (Harvard 2018).

Many guidelines are released by many medical organizations, including the World Health Organization, advocating reduction of saturated fat intake to promote health and to reduce the risk from cardiovascular diseases. Many researchers also recommend a diet very low in saturated fat to lower the risks of cardiovascular diseases (Hooper *et al.* 2015), diabetes, or death (Sacks *et al.* 2017).

Unsaturated fats

Most of the fats obtained from plants and fishes are unsaturated in nature (US Dept of Agril 2015).

Mono-unsaturated fats

Monounsaturated fats have only one (mono) carbon-to-carbon double bond (-C=C-). It means that these fats have only one unsaturated double bond (of *cis* type) in the fatty acid chain with all of the remainder carbon atoms is having single bonds (Am Heart Assoc, Monounsaturated fat 2015).

Oils that contain monounsaturated fats are typically liquid at room temperature but start to turn solid when

chilled (Am Heart Assoc, Monounsaturated fat 2015).

The discovery of the fact that monounsaturated fats could be helpful to our health came from the Seven Countries Study during the 1960s. It revealed from the study that people of Greece and other parts of the Mediterranean region showed very low rate of heart disease despite taking high fat rich diet. The main fat in their diet was Olive oil which contains mainly monounsaturated fat (Harvard 2018).

Monounsaturated fats can help to reduce the level of bad (LDL) cholesterol in the blood and so can lower the risk of heart disease and stroke. They can also provide nutrients to help develop and maintain the body cells. Oils rich in monounsaturated fats can also add vitamin E to the diet, which act as an antioxidant (Am Heart Assoc, Monounsaturated fat 2015).

Good sources of monounsaturated fats are olive oil, peanut oil, canola oil, avocados, most nuts, as well as high-oleic sunflower oil and sesame oil (Am Heart Assoc, Monounsaturated fat 2015; Harvard 2018).

Poly unsaturated fats

Polyunsaturated fatty acids have two or more double bonds in their carbon chain. There are two main types of polyunsaturated fatty acids: omega-3 fatty acids and omega-6 fatty acids. The numbers (3 or 6) refer to the distance between the beginning of the carbon chain and the first double bond. Both of these types of fatty acids offer different health benefits. Poly unsaturated fats having the tendency to remain liquid at room temperature with varying degrees of viscosity (Harvard 2018).

Polyunsaturated fats are required to build cell membranes and the covering of nerves. They are also required for blood clotting, muscle movement and inflammation (Harvard 2018).

Omega-3 fatty acids

Omega-3 fatty acids may prevent and even can treat heart diseases and stroke. These can reduce blood pressure, raise HDL, lower the level of triglycerides and can prevent lethal heart rhythms from arising. As per some research reports, they may help to reduce the need for corticosteroid medications in people with rheumatoid arthritis. Omega-3 fats are perhaps linked with a wide range of other health improvements including reducing risk of dementia according to a systematic review of the Agency for Healthcare Research and Quality (Harvard 2018).

Sources

Alpha Linolenic acid (ALA): Flaxseeds, walnuts and their oils are among the richest dietary sources of ALA. Canola oil is also an excellent source of it (Table 1).

Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA): Oily fish are the major dietary source of them. Humans can synthesize EPA and DHA from ALA (Oregon State Unv 2014).

Omega-6 fatty acids

Linoleic acid and other omega-6 fatty acids can act to protect us from heart diseases. Vegetable oils such as safflower, soybean, sunflower, walnut and corn oils are rich in omega-6 fatty acids (Table 1) (Harvard 2018).

Source

Linoleic acid: Food sources of Linoleic acid include vegetable oils like soybean, safflower, and corn oil; many nuts, seeds and also some vegetables.

Arachidonic acid: Only animals can convert Linoleic acid to Arachidonic acid in their body system. For this reason, Arachidonic acid is present in meat, poultry, and eggs in small amounts.

So, humans can also synthesize Arachidonic acid from Linoleic acid (Oregon State Unv 2014).

The *Cis* and *Trans* bonds

These are the nomenclature of typical bonding type of hydrogen with carbon. All bonding of Mono unsaturated fatty acids is of *cis* type. Generally, the bonds of poly unsaturated fatty acids are also of *cis* type. The *trans* type bonds are found naturally in a few cases and artificially in some situations.

In the *cis* fatty acids, the two parts of fatty acid molecules are on the same side of the double bonds, *i.e*, functional groups are on the same side. In the *trans* form, two parts of fatty acid molecules are on opposite sides of double bonds (CSPINET 2004). So, the fat may exists as *cis* or *trans* isomers depending on the geometry of the double bond.

The trans fats

Trans fats, also called trans-unsaturated fatty acids or trans fatty acids, are a type of unsaturated fatty acids that occur in small amounts in nature (Trans fat taskforce report of Canada 2006), but widely produced industrially as a bi product (CSPINET 2004).

Formation of Trans fats

Trans fats are created following two main ways.

Naturally occurring trans fats

Some trans fats are made by bacteria that live in the fore-stomach (rumen) of cattle, sheep, goats, deer etc.,

So, such trans fats may occur naturally in animal meats like beef, mutton, chevon etc. as well as in dairy products like milk, cheese, butter and cream (Saxelby 2018). These foods contain trans fats at very small quantities (Am Heart Assoc, Trans fat 2017).

Artificially produced trans fats

A. Partial hydrogenation of unsaturated vegetable oils.

Artificial trans fats are created in an industrial process that adds additional hydrogen to liquid vegetable oils (unsaturated fats) to make them solid saturated fats (Am Heart Assoc, Trans-fat 2017). For this, the oil is heated in the presence of hydrogen and a catalyst (hydrogen is bubbled through them by force in the presence of a catalyst) to transform them into solid and semi-solid fats (Saxelby 2018). Theoretically, all double-bonds of the oils should be converted to single bonds and all the unsaturated fats should be converted to saturated fats in full hydrogenation. But generally incomplete or partial hydrogenation is performed. In such partial hydrogenation, only some double-bonds are converted into single bonds. As a side effect of the partial hydrogenation process, some of the *cis* double-bonds are converted into *trans* double-bonds, resulting in trans fatty acids (CSPINET 2004).

So, due to change of molecular structure of fatty acids, 30 to 60 percent of bonds become trans type. The trans fats are the chemically opposite of the usual cis form (Saxelby 2018). Thus, the healthful unsaturated oils are converted into some harmful semisolid fats for our action.

Most trans-fats are monounsaturated (one double bond) fatty acid. The shape of trans-fat molecules is more like cholesterol-raising saturated fat than a typical monounsaturated fatty acid. Perhaps for that reason, it increases cholesterol levels in blood (CSPINET 2004).

The trans fatty acid content of industrially hydrogenated fats varies widely and may account for up to 60% of the fatty acid content, whereas the trans fatty acid content of fats of animal source (natural) is considerably lower and accounts for 2%–5% of the total fatty acid content (Weggemans *et al.* 2004).

So, the primary dietary source for trans fats in processed foods is the partially hydrogenated oils (Am Heart Assoc, Trans-fat 2017).

B. Refining of vegetable oils

Edible oils are refined to remove certain impurities or naturally present materials (free fatty acids, phospholipids, carbohydrates, proteins and/or their degradation by-products). Removal of these materials is required to get desired color, taste and aroma of the oils (Nawar 1996).



Fig. 1. Foods deep fried in Vanaspati, a popular choice of Indians.

The vegetable oils are generally heated between 60 ^{0}C and 100 ^{0}C before deodorization to improve organoleptic characteristics of the oils. During that deodorization process, the temperature is generally raised up to 180 ^{0}C to 270 ^{0}C. That level of heating leads to the formation of trans fatty acids in the vegetable oils (Martin *et al.* 2007).

C. Frying

Frying at some very high temperatures is the main basis of preparation of most of the processed and fried foods. During such deep frying (150 ^{0}C–190 ^{0}C or more), the hot oil acts as the heat transfer medium and contributes to the texture and flavor of the fried foods (Bouchon 2009). During this process, the edible oils or fats undergo various chemical reactions (Goyal and Sundararaj 2009).

The oil qualities of these fried foods were analyzed by Fourier transform infrared (FTIR) spectroscopy. Loss of cis double bonds along with an increase in trans double bonds was observed in these studies (Goburdhun *et al.* 2001), thus confirming the formation of trans fatty acids during such high temperature heating of oils.

Many trans fatty acids can be formed during reusing the oil many times under high temperature (Liu *et al.* 2007).

Reasons for creation and use of trans fats

The solid or semisolid hydrogenated fats are easy to use, inexpensive to produce and last for a long time. These fats give the processed and fried foods a desirable taste and texture. Many restaurants and fast-food outlets use these fats to deep-fry foods because oils with trans fats can be used many times in commercial

fryers (Am Heart Assoc, Trans-fat 2017). So, partially hydrogenated oils have been used to replace butter, lard, palm oil, coconut oil and other hard (saturated) fats in many deep fried and processed foods (CSPINET 2004).

Trans fat containing food

According to the Food and Drug Administration (FDA), we consumed about 5.6 grams of trans fat per day during 1994-96. Most of those trans-fats came from the 40,000-plus foods that contain partially hydrogenated vegetable oil (CSPINET 2004).

All the food or food items prepared with hydrogenated vegetable oils contains trans fats. The list includes margarines, all biscuits, pastries, cookies, crackers, icings (CSPINET 2004); cakes, ice cream, bread (www.diabetes.co.uk, Trans fats); movie-popcorn (popcorn fried in hydrogenated fats available in movie halls), potato crisps, corn chips, sausage rolls, meat pies, French fries, chips, wedges, battered fish, nuggets, spring rolls, crumbed chicken, fish fingers, Danish pastries, croissants, snails and apple pies (Saxelby 2018); pizza, coffee creamer and all deep-fried foods at restaurants (CSPINET 2004). So, almost all snack foods, packaged baked goods and frying fast foods contain trans fats (CSPINET 2004).

Effects of trans fats on health

Cardiovascular diseases

1. High levels of serum cholesterol have a strong relation with high prevalence of heart diseases (Caggiula and Mustad 1997). High level of serum cholesterol, particularly LDL cholesterol can promote the development of atherosclerosis or coronary heart disease (Mensink and Katan1990).

Trans fatty acid consumption raises the Low-Density and Very Low Density (LDL and VLDL) cholesterol levels as well as lowers the level of High Density (HDL) cholesterol. It also leads to reduced triglyceride uptake and production of free fatty acids (Mozaffarian 2006). All these factors may cause heart diseases.

Even a very small amount of trans fats can be harmful to our health. For every 2% of calories from trans fat consumed daily, the risk of heart disease rises by 23% (Harvard 2018).

Evidence suggests that trans fats perhaps increase the risk of coronary heart disease about two-and-a-half times the heart disease risk of saturated fats (Hu *et al.*1997).

2. Trans fatty acids increase the levels of Lp (a) lipoprotein and reduce the LDL cholesterol, particle size of which further heightens the risk of coronary heart diseases. There are several other mechanisms through which trans fats may stimulate both lipid and non-lipid risk factors for cardio- vascular diseases (Mozaffarian 2006).

3. Trans fats promote systemic inflammation by increasing the levels of C-reactive protein (CRP) leading to thickening of the arteries which may lead to sudden death due to cardiac failure (Mozaffarian *et al.* 2004, Lopez 2005).

4. Trans fatty acids cause endothelial dysfunction by increasing circulating bio-markers including soluble inter cellular adhesion molecule -1, soluble vascular-cell adhesion molecule -1 and E-selectin (Lopez 2005). Endothelial dysfunction is a key step in the development of atherosclerosis (Mozaffarian *et al.* 2004).

Type 2 Diabetes

Trans fats create inflammation, which is also linked with diabetes and other chronic conditions. They contribute to insulin resistance, which increases the risk of developing type 2 diabetes (Harvard 2018).

It was observed that the risk of the development of type-II diabetes is associated with intake of trans fatty acid in a study of 14 years. It was observed that for 2% increase in energy from trans fatty acids can increase the relative risk of type 2 diabetes to a very high level. If that trans fats are replaced by poly-unsaturated fats, the risk of Type 2 diabetes will reduce 40% (Salmeron *et al.* 2001).

Studies carried out at National Institute of Nutrition (NIN), Hyderabad, India to evaluate the effects of trans fatty acids of Vanaspati (commonly used hydrogenated vegetable oil in India, usually made by hydrogenation of Palm oil) showed that both of the saturated fatty acids (10% energy) and trans fatty acids (3% energy) increased insulin resistance. However, the effects of trans fats were greater than saturated fats in increasing insulin resistance in rats (Ghafoorunissa 2008).

Increase of C reactive protein due to trans-fat intake may also lead to diabetes (Mozaffarian *et al.* 2004). Trans fats have shown to increase insulin resistance and seem to have a unique cardio-metabolic imprint that is linked to insulin-resistance and metabolic-syndrome pathways (Mozaffarian 2006).

Effect on pregnancy and newborn babies

An association was found between high intake of trans fatty acids and the risk of pre-eclampsia (pregnancy induced hypertension). In the study, trans fatty acid intake was estimated by the trans fatty acid content of the cell

Table 1. Composition of different commonly used vegetable oils (in %).

Name	Saturated fatty acids	Poly Unsaturated fatty acids			Mono Unsaturated fatty acids
		Omega 6 fatty acids	Omega 3 fatty acid (Alpha Linolenic Acid)	Total	
#Almond oil	8.2	17.4	0	17.4	70
#Apricot Kernel oil	6.3	29.3	0	29.3	60
#Avocado oil	11.56	12.53	1	13.53	70.56
#Canola oil	7.1	20.3	9.3	29.6	58.6
#Coconut oil	86.5	1.8	0	1.8	5.8
#Corn oil	13.17	53.52	1.16	54.68	27.47
#Cottonseed oil	25.8	51.6	0.2	51.8	17.8
#Flaxseed (Linseed) oil	9.4	12.7	53.3	66	20.2
#Grape-seed oil	9.5	69.6	0.1	69.7	16.1
#Hazelnut oil	7.3	10.1	0	10.1	78
#Mustard oil	6.26	15.33	5.9	21.23	59.2
#Oat oil	18.35	39.08	1.79	40.87	35.1
#Olive oil	13.46	9.21	0.79	10	73.9
#Walnut oil	9.0	52.9	10.4	63.3	22.7
#Pea nut (Ground nut) oil	16.9	32	0	32	46.2
#Rice Bran oil	19.2	33.4	1.6	35	39.3
#Safflower oil	6.21	74.6	0	74.6	14.36
^Palm oil	49.9	10.1	0.4	10.5	39.2
^Palm Kernel oil	82.1	2.4	0	2.4	15.4
*Wheat germ oil	26.1	53.0	4.68	57.68	16.2
*Sesame oil	16.4	41.8	0.51	42.3	41.4
*Pumpkin oil	20.2	54.7	0.43	55.1	24.7
*Argan oil	19.2	34.6	0.39	35.0	45.8
*Sunflower oil	8.65 (up to 18)	37.8 (up to 69)	0.28	38.1	53.2 (up to 82)[$]
*Soybean oil	13.5	54	8.3	62.3	24.5

Cordain (thepaleodiet.com.). ^ Mancini *et al.* (2015), * Rueda *et al.* (2014).

[$]The concentration of different types of fatty acids may vary for the factors like breed of plant producing oil seeds. High linoleic, high oleic, mid oleic and high stearic Sunflower oils are made available through designed plant breeding and industrial processing.
[$]The compositions of fresh oils are shown. For deep frying or hydrogenation, the composition may be changed.
[$]The Omega 6 and Omega 3 fatty acids are essential fatty acids for us.
[$]Some other types of fats of negligible amount are also present in the oil seeds.

walls of red blood cells. It was noticed that women who developed pre-eclampsia had approximately 30% higher trans fatty acid levels in red blood cells than women who did not develop this disorder (Yli-Jama *et al.* 2002). Trans fats may have relation with shortening of pregnancy period also (Dhaka *et al.* 2011). Consumption of trans fatty acids has shown to increase the risk for ovulatory infertility in women (Chavarro 2007).

Studies on humans have shown that trans fatty acids are transferred to the foetus, as they were found in the same levels in the blood of mothers and new born infants (Berghaus *et al.* 1998, Elias and Innis 2001).

Trans fats can compromise the development of the fetus. There is a significant negative relationship between birth weight and a trans fat (trans-9) concentration in maternal plasma phospholipids during early stages of pregnancy (Hornstra 2006). Trans fats may have adverse effects on growth and development through interfering with essential fatty acid metabolism, direct effects on membrane structures or metabolism, or secondary to reducing the intake of the cis essential fatty acids either in the mother or the child (Innis 2006).

Cancer

The adipose concentration of trans fats showed a positive association with breast cancer, not attributable to differences in age, body mass index, exogenous hormone used or socio-economic status (Kohlmeier *et al.* 1997, Dhaka *et al.* 2011).

Trans fat may cause colon cancer (Dhaka *et al.* 2011).

Obesity

Obesity research indicates that trans-fat may increase weight gain and abdominal fat deposits (Ricerus *et al.* 2002, Dhaka *et al.* 2011).

Allergy

The incidence of asthma, allergic cold and asthmatic eczema in children aged 13–14 years was investigated in some selected centres around the world. A positive association was found between the intake of trans fatty acids and these diseases (Weiland *et al.* 1999). Such observations were noted by Dhaka *et al.* (2011). But such an association was not observed for the intake of monounsaturated and polyunsaturated fatty acids (Willett *et al.* 1993).

Other health effects

Trans fatty acids can cause disorders of nervous system and vision in infants (Dhaka *et al.* 2011). It can cause Alzheimers and may be a potential cause of liver dysfunction (www.diabetes.co.uk, Trans fats).

As the hydrogenation process destroys some of the vitamin K in vegetable oils, which might be a problem for consumers who have marginal intakes of that vitamin (CSPINET 2004).

Evidences have shown that higher intake of saturated and trans-fat since midlife and lower polyunsaturated to saturated fat ratio are associated with a faster rate of cognitive decline and it also might be associated with neurodegenerative diseases (Morris *et al.* 2004).

Trans fats - cause of death

Harvard researchers estimate that trans fats cause up to 228,000 cases of heart disease annually (Kloss 2018). Both WHO and researchers of Harvard University estimates that trans fats may be the cause of death of 50,000 people per year (Saxelby 2018, Kloss 2018).

Effects of trans fats: natural vs synthesized

The good news is that there is no evidence of detrimental health effect performed by the natural forms of trans fats (Saxelby 2018). Instead, it is reported that these natural trans fats provide health benefits (Bassett *et al.* 2010, Gebauer *et al.* 2011).

Dilatory intake limit of fats

WHO recommended a limit up to 1% and 10% of energy in diet to be derived from trans fatty acids and saturated fatty acids, respectively (Dhaka *et al.* 2011). If we need to lower our blood cholesterol, we have to limit use of the saturated fat not more than 5 to 6 percent of total calories. For someone eating 2,000 calories a day, that is about 13 grams of saturated fat (Am Heart Asso, Saturated fat 2015).

In November 2013, the U.S. Food and Drug Administration (FDA) made a preliminary determination that partially hydrogenated oils are no longer Generally Recognized as Safe (GRAS) in human food (Am Heart Assoc, Trans fat 2017).

Boiling and repeated boiling of oils – some study reports

Deep frying of fat at 180 °C or above is one of the most common food processing methods used for preparing of processed foods worldwide. A series of complex reactions such as oxidation, hydrolysis, isomerization and polymerization take place during the deep-fat frying course and they influence quality attributes of the final product such as flavour, appearance, taste, shelf life and nutrient composition (Goyal and Sundararaj 2009, Zhang et al. 2012). The influence of these reactions results from a number of their products including volatile compounds, hydrolysis products, oxidized triacylglycerol monomers, cyclic compounds, trans configuration compounds, polymers, sterol derivatives, nitrogen- and sulphur-containing heterocyclic compounds, acrylamide, etc. which are present in both frying oil and the fried foods (Zhang *et al.* 2012).

In Wistar rats treated with the repeatedly heated cooking oil revealed higher peroxide value in comparison to oil that has been unheated or singly heated. Histo-pathological observation depicted significant damage in

jejunum, colon and liver of animals that received oil heated repeatedly for 3 times. The altered antioxidant status reflects an adaptive response to oxidative stress (Venkata and Subramanyam 2016).

Trans fatty acids were estimated in six commonly used fat/oils in India (refined soybean oil, groundnut oil, olive oil, rapeseed oil, clarified butter, partially hydrogenated vegetable oil), before and after subjecting them to heating/frying at 180 °C and 220 °C. All six fats/oils subjected to heating/frying demonstrated an increase in trans fatty acids, saturated fatty acids and decrease in cis unsaturated fatty acids (Bhardwaj *et al.* 2016).

The Indian condition

In India, the street restaurants, hotels, festive food suppliers, sweet shops etc. use saturated fats and hydrogenated fats with repeated boiling at some very high temperatures (Fig. 1) (Pattanayak 2014). Deep fried items are famous everywhere in India, but the deep black coloured oil generally used in that purpose is loosely sold and having very doubtful source and quality (Pattanayak 2017).

The trans fats are added in the processed foods in India due to some reasons. Partially hydrogenated vegetable fats (Vanaspati/margarine) can replace naturally solid, saturated fatty acids (Ghee, butter etc.). Hydrogenated fats are preferred in commercial food processing as they are economical, allow a longer shelf life and give desirable taste, texture and shape (Agarwal *et al.* 2008). It is used in Indian cooking and in the preparation of commercially fried, processed, bakery, ready-to-eat and street foods (Ghafoorunissa 2008), sweet preparation (Agarwal *et al.* 2008) etc. Trans fats in biscuits and sweets range 30-40 and 6-26% of total fatty acids respectively (Ghafoorunissa 2008).

The main hydrogenated vegetable oils used in India are Vanaspati and Dalda, both are very rich in trans fats. Vanaspati provides up to 40% trans-fat (Ghafoorunissa 2008). It is the main source of trans fatty acid in Indian food items. Vanaspati accounts for 10% of total production of edible oils, with a maximum consumption of 20 g/person/day in north India (Ghafoorunissa 2008).

Trans fats are present in all fast foods, bakery items, all biscuits, sweets, chocolates, spreads, soups, salad dressings and snacks sold in India. The trend of eating out in the urban population and consumption of food in hotels and restaurants can be considered unhealthy as the food prepared there is very high in trans fats (Dhaka *et al.* 2011).

In India, there is no system to monitor and regulate the amount of trans fats in processed foods and hence a stringent food law is immediately required (Dhaka *et al.* 2011). But there is no such regulation on trans fatty acids content in vanaspati, bakery fats and shortenings (Ghafoorunissa 2008).

Practically, the level of consciousness of Indians about effect of saturated fats and trans fats is perhaps far away from creation of any such pressure to get any legislative control.

The alternatives

For industry

In light of the research findings, provisions should be there to bring down trans fatty acid intake to zero and new technology of hydrogenation of oils is to be developed for that purpose. At the same time, efforts should be there to preserve the desirable properties contributed by trans fatty acids to the hydrogenated oils (Dhaka *et al.* 2011).

For personal safety

The best way is to stop intake of any food having trans fat completely. Following steps may be followed for that purpose.

1. Use of oils such as olive and sunflower oils instead of margarine and butter during cooking or other purposes may be a better option. For instance, when baking a cake, a recipe that works well using oil instead of solid fats may be adopted.
2. Avoiding of margarine or butter in the dish.
3. Avoiding purchase of commercial cakes, slices, biscuits, muffins, quiches and pies. Instead, baking of such foods at home using oils may be performed.
4. Avoiding eating of pastry, including shortcrust and puff.
5. Avoiding of all deep-fried fast foods (Saxelby 2018).

Other important points

1. Most oils are high in monounsaturated or polyunsaturated fats and low in saturated fats. Oils from plant sources (vegetable and nut oils) do not contain any cholesterol. In fact, no plant foods contain cholesterol (US Dept Agril 2015).
2. Some fats remain almost solid in room temperature due to huge saturated fat content. Beef fat (tallow, suet), chicken fat, pork fat (lard), butter etc. are example. These may be avoided.
3. Oils like coconut oil, palm oil, palm kernel oil etc. are high in saturated fats and for nutritional purposes should be considered to be solid fats (US Dept Agril 2015) and

so may be avoided.

So, it can be said that mono unsaturated fats are best, poly unsaturated fats are acceptable with calculation of Omega 3 fatty acids and Omega 6 fatty acids, saturated fats are bad and trans fats are almost poisonous to our health.

To stay away from some very serious health effects, we must have to reduce the intake of saturated fats drastically and to delete trans fats from our diet totally.

Table 1 shows composition of different commonly used vegetable oils, which may assist us to choose the proper oils for our cooking or use in other diatory preparations. Use of a few good oils may be a better option than use of single oil continuously for getting different essential fatty acids and other beneficial ingredients from them.

Shibabrata Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

ACKNOWLEDGEMENT: The author is thankful to Mr. Sandipan Das, M.Sc. B.Ed., Assistant teacher, Panchkahania Higher Secondary School, Paschim Medinipur, West Bengal for the assistance rendered by him.

REFERENCES

Agrawal A, Gupta R, Varma K, Mathur B (2008) High trans fatty acid content in common Indian fast foods. Nutr Food Sci 38(6): 564-569.

American Heart association. Dilatory fats (2014) https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/dietary-fats. Accessed on 05.03.19.

American Heart association. Mono-unsaturated fat (2015) https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/monounsaturated-fats. Accessed on 15.03.19.

American Heart association. Saturated fat (2015) https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/saturated-fats. Accessed on 05.03.19.

American Heart association. *Trans* fats (2017) https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/trans-fat. Accessed on 02.04.2019.

Bassett CMC, Edel AL, Patenaude AF, McCullough RS, Blackwood DP *et al*. (2010) Dietary vaccenic acid has antiatherogenic effects in $LDLr^{-/-}$ mice. J Nutrition 140(1): 18-24.

Berghaus TM, Demmelmair H, Koletzko B (1998) Fatty acid composition of lipid classes in maternal and cord plasma at birth. Eur J Pediatr 157: 763-768.

Bhardwaj S, JainPassi S, Misra A, Pant KK, Anwar K *et al.* (2016) Effect of heating/reheating of fats/oils, as used by Asian Indians, on *trans* fatty acid formation. Food Chemistry 212: 663-670.

Bouchon P (2009) Understanding oil absorption during deep-fat frying. Adv Food Nutr Res 57: 209-234.

Caggiula AW, Mustad VA (1997) Effects of dietary fat and fatty acids on coronary artery disease risk and total and lipoprotein cholesterol concentrations: epidemiologic studies. Am J Clin Nutr 65: 1597S-1610S.

Center for Science in the Public Interest (CSPINET) (2004). About trans fat and partially hydrogenated oils. https://cspinet.org/resource/qa-about-trans-fat-and-partially-hydrogenated-oils. Accessed on 10.03.19.

Chavarro JE, Rich-Edwards JW, Rosner BA, Willett WC (2007) Dietary fatty acid intakes and the risk of ovulatory infertility. Am J Clin Nutr 85(1): 231-237.

Cordain L. Vegetable oil fatty acid composition. https://thepaleodiet.com/vegetable-oil-fatty-acid-composition/ Accessed on 15.04.2019

Dhaka V, Gulia N, Ahlawat KS, Khatkar BS (2011) Trans fats-sources, health risks and alternative approach - a review. J Food Sci Technol 48(5): 534-541.

Elias SL, Innis SM (2001) Infant plasma trans, n-6, and n-3 fatty acids and conjugated linoleic acids are related to maternal plasma fatty acids, length of gestation, and birth weight and length. Am J Clin Nutr 73: 807-814.

Gebauer SK, Chardigny JM, Jakobsen MU, Lamarche B, Lock AL *et al.* (2011) Effects of ruminant trans fatty acids on cardiovascular disease and cancer: a comprehensive review of epidemiological, clinical and mechanistic studies. Adv Nutr 2: 332-354.

Ghafoorunissa G (2008) Role of trans fatty acids in health and challenges to their reduction in Indian foods. Asia Pac J Clin Nutr 17: 212-215.

Goburdhun D, Jhaumeer-Laulloo SB, Musruck R (2001) Evaluation of soybean oil quality during conventional frying by FTIR and some chemical indexes. Int J Food Sci Nutr 52(1): 31-42. Cited in Bhardwaj S, JainPassi S, Misra A (2011) Overview of trans fatty acids: biochemistry and health effects. Diabete Metabol Synd Clinic Res Rev 5: 161-164.

Goyal N, Sundararaj P (2009) Are we unknowingly consuming trans fats and abused oils? Bull Nutr Found India 30(2): 4-7. Cited in Bhardwaj S, JainPassi S, Misra A (2011) Overview of trans fatty acids: biochemistry and health effects. Diabete Metabol Synd Clinic Res Rev 5: 161-164.

Harvard health publishing (2018) Harvard Medical School. The truth about fats: the good, the bad, and the in-between. www.health.harvard.edu/staying-healthy/the-truth-about-fats-bad-and-good.

Hooper L, Martin N, Abdelhamid A, Davey Smith G (2015) Reduction in saturated fat intake for cardiovascular disease. Cochrane Database of Systematic Rev 10 (6): 1-109.

Hornstra G, Van Eijsden M, Dirix C, Bonsel G (2006) Trans fatty acids and birth outcome: some first results of the MEFAB and ABCD cohorts. Atheroscler Suppl 7(2): 21-23. Cited in: Mueller A, Thijs C, Rist L, Simoes-Wust AP, Huber M *et al.* (2010) Trans fatty acids in human milk are an indicator of different maternal dietary sources containing trans fatty acids. Lipids 45: 245-251.

Hu FB, Stampfer MJ, Manson JE, Rimm E, Colditz GA *et al.* (1997) Dietary fat intake and the risk of coronary heart disease in women. New England J Medic 337 (21): 1491-1499.

Innis SM (2006) Trans fatty intakes during pregnancy, infancy and early childhood. Atheroscler Suppl 7(2): 17-20.

Kloss K (2018) 10 Shocking foods that sneak in trans fats. Reader's Digest. https://www.rd.com/health/healthy-eating/trans-fat-foods/. Accessed on 01.04.19.

Kohlmeier L, Simonsen N, van 't Veer P, Strain JJ, Martin-Moreno JM *et al.* (1997) Adipose tissue trans fatty acids and breast cancer in the European community multicenter study on antioxidants, myocardial infarction, and breast cancer. Cancer Epidemiol Biomark Prev 6(9): 705-710.

Liu WH, Stephen Inbaraj B, Chen BH (2007) Analysis and formation of trans fatty acids in hydrogenated soyabean oil during heating. Food Chem 104(4):1740-1749. Cited in: Dhaka V, Gulia N, Ahlawat KS, Khatkar BS (2011) Trans fats-sources, health risks and alternative approach - a review. J Food Sci Technol 48(5): 534-541.

Lopez GE, Schulze MB, Meigs JB, Manson JE, Rifai N *et al.* (2005) Consumption of trans fatty acids is related to plasma biomarkers of inflammation and endothelial dysfunction. J Nutr 135(3): 562-566.

Mancini A, Imperlini E, Nigro E, Montagnese C, Daniele A *et al.* (2015) Biological and nutritional properties of Palm oil and Palmitic acid: effects on health. Molecules 20: 17339-17361.

Martin CA, Milinsk MC, Visentainer JV, Matsushita M, De-Souza NE (2007) Trans fatty acid-forming processes in foods: a review. An Acad Bras Cienc 79(2): 343-350.

Mensink RP, Katan MB (1990) Effect of dietary trans fatty acids on high-density and low-density lipoprotein cholesterol levels in healthy subjects. N Engl J Med 323: 439-445.

Morris MC, Evans DA, Bienias JL, Tangney CC, Wilson RS (2004) Dietary fat intake and 6-year cognitive change in an older biracial community population. Neurology 62(9): 1573-1579.

Mozaffarian D, Rimm EB, King IB, Lawler RL, McDonald GB, Levy WC (2004) Trans fatty acids and systemic inflammation in heart failure. Am J Clin Nutr 80(6): 1521-1525.

Mozaffarian D, Katan MB, Ascherio A, Stampfer MJ, Willett WC (2006) Trans fatty acids and cardiovascular disease. N Engl J Med 354(15): 1601-1613.

Nawar WW (1996) Lipids. In: Fenema OR, editor. Food chemistry. New York: Marcel Dekker. Cited in Bhardwaj S, JainPassi S, Misra A (2011) Overview of trans fatty acids: biochemistry and health effects. Diabet Metabol Syndr Clinic l Res Rev 5: 161-164.

Oregon State University, Micronutrient information centre (2014) Essential fatty acids. https://lpi.oregonstate.edu/mic/other-nutrients/essential-fatty-acids. Accessed on 12.03.19.

Pattanayak S (2014) Cancer – the ultimatum of our chemical based civilization. Explor Anim Med Res 4(1): 5-7.

Pattanayak S (2017) Processed foods – are they safe? Explor Anim Med Res 7(2): 125-131.

Ricerus U, Arner P, Brismar K, Vessby B (2002) Treatment with dietary trans 10 - cis 12 conjugated linoleic acid causes isomer specific insulin resistance in obese men with the metabolic syndrome. Diabetes Care 25: 1516-1521.

Rueda A, Seiquer I, Olalla M, Giménez R, Lara L *et al.* (2014) Characterization of fatty acid profile of Argan oil and other ddible vegetable oils by Gas Chromatography and Discriminant Analysis. J Chemist 2014: 1- 8.

Sacks FM, Lichtenstein AH, Wu JH, Appel LJ, Creager MA *et al.* (2017). Dietary fats and cardiovascular disease: a presidential advisory from the American Heart Association. Circulation 136 (3): e1–e23.

Salmeron J, Hu FB, Manson JE, Stampfer MJ, Colditz GA *et al.* (2001) Dietary fat intake and risk of type II diabetes in women. Am J Clin Nutr 73: 1019-1026.

Saxelby C (2018) 13 trans-fat foods to remove from your diet! https://foodwatch.com.au/blog/fats-and-oils/item/13-trans-fat-foods-to-remove-from-your-diet.html. Accessed on 17.04.2019.

Trans Fat Task Force of Health Canada and Heart and Stroke Foundation of Canada (2006). "TRANSforming the Food Supply" https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/tf-gt_rep-rap-eng.pdf. Accessed on 12.03.2019.

Trans fats. https://www.diabetes.co.uk/food/trans-fats.html. Accessed on 12.03.19.

US Department of Agriculture (2015) What are oils? (https://web.archive.org/web/20150609080528/http://www.choosemyplate.gov/food-groups/oils.html). Accessed on 15.03.19.

Venkata RP, Subramanyam R (2016) Evaluation of the deleterious health effects of consumption of repeatedly heated vegetable oil. Toxicol Reports 3: 636-643.

Weggemans RM, Rudrum M, Trautwein EA (2004) Intake of ruminant versus industrial trans fatty acids and risk of coronary heart disease - what is the evidence? Eur J Lipid Sci Technol 106: 390-397.

Weiland SK, von Mutius E, Hüsing A, Asher MI (1999) On behalf of the ISAAC steering committee. Intake of trans fatty acids and prevalence of childhood asthma and allergies in Europe. Lancet 353: 2040-2041. Cited in Dhaka V, Gulia N, Ahlawat KS, Khatkar BS (2011) Trans fats-sources, health risks and alternative approach - a review. J Food Sci Technol 48(5): 534-541.

Willett WC, Stampfer MJ, Manson JE, Colditz GA, Speizer FE *et al.* (1993) Intake of trans fatty acids and risk of coronary heart disease among women. Lancet 341: 581-585. Cited in Dhaka V, Gulia N, Ahlawat KS, Khatkar BS (2011) Trans fats-sources, health risks and alternative approach - a review. J Food Sci Technol 48(5): 534-541.

Yli-Jama P, Meyer HE, Ringstad J, Pedersen JI (2002) Serum free fatty acid pattern and risk of myocardial infarction: a case-control study. J Intern Med 251: 19-28.

Zhang Q, Saleh ASM, Chen J, Shen Q (2012) Chemical alterations taken place during deep-fat frying based on certain reaction products: a review. Chemist Physic Lipids 165(6): 662-681.

Zundel J. What are fats? - functions and molecular structure. https://study.com/academy/lesson/what-are-fats-functions-molecular-structure-quiz.html.

***Cite this article as:** Pattanayak S (2019) Trans-fats of processed and fried foods – a choice for taste or serious health problems? Explor Anim Med res 9(1): 5-14.